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Installation Details for Runway Centerline and Touchdown Lighting Systems

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ADVISORY CIRCULAR

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

SUBJECT: INSTALLATION DETAILS FOR RUNWAY CENTERLINE AND TOUCHDOWN ZONE LIGHTING SYSTEMS

1. PURPOSE. This advisory circular describes standards for the design, installation, and maintenance of runway centerline and touchdown zone lighting systems.

2. CANCELLATION. AC 150/5340-4B, Installation Details for Runway Centerline and Touchdown Zone Lighting Systems, dated May 6, 1969, is cancelled.

3. REFERENCES. The publications listed under Appendix 1, Bibliography, are applicable to this advisory circular.

4. EXPLANATION OF REVISIONS. In addition to minor changes in the text, the following major revisions have been made:

   a. Criteria and details added for the installation of inpavement transformer housings and conduit systems in new rigid and flexible pavements; also applicable to overlays.

   b. Deleted stepless-type regulators and control panels from drawings.

5. HOW TO OBTAIN ADDITIONAL COPIES. Additional copies of this advisory circular may be obtained from the Department of Transportation, Publications Section, TAD-443.1, Washington, D.C. 20590.

William V. Vitale

WILLIAM V. VITALE
Director, Airports Service

Initiated by: AAS-550

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1. INTRODUCTION. Runway centerline and touchdown zone lighting systems are designed to facilitate landings, rollouts, and takeoffs. The touchdown Zone light8 are primarily a landing aid while the centerline lights are wed for both landing and takeoff operations.

2. SELECTION CRITERIA. Runway centerline lights and touchdown zone lights are required for Category II and Category III runways and for Category I runway8 used for landing operations below 2,400 feet (750 m) Runway Visual Range (RVR). Runway centerline lights are required on runways used for takeoff operations below 1,600 feet (480 m) RVR. Although not operationally required, runway centerline lights are recommended for Category I runways greater than 170 feet (50 m) in width or when used by aircraft with approach speeds over 140 knots.

3. CONFIGURATION.

a. Runway Centerline Lighting.

(1) Location. The lights are located along the runway centerline at 50-foot (15 m) intervals as shown in Figure 1. The line of lights is offset a maximum of 2 feet (0.6 m) to either the right or left side of the runway marking and should be to the opposite side of the centerline marking from the major taxlway turnoffs.

(2) Color Coding. The last 3,000-foot (900 m) portion of the lighting system is color coded to warn pilots of the impending runway end. Alternate red and white lights are installed as seen from 3,000 feet (900 m) to 1,000 feet (300 m) *from* the runway end, and *red* lights are installed in the last 1,000-foot (300 m) portion.

(3) Displaced Threshold. On runway8 having centerline lights, the centerline lights are extended into the displaced threshold area. If the displaced area is not used for takeoffs, or if the displaced area is used for takeoffs but is less than 700 feet (110 m) in length, the centerline lights are blanked out in the landing direction. For displaced threshold areas over 700 feet (110 m) in length and used for takeoffs, the centerline lights in the displaced area are circuited separately from the centerline lights in the nondisplaced runway area to permit turning "off" the centerline lights in the displaced area during landing operations. If the displaced threshold area also contains a medium intensity approach light system, the control of the approach lights and displaced threshold area centerline lights are interlocked to insure that when the approach lights are "on" the displaced area centerline lights are "off" and vice versa. If the displaced threshold area contains a high intensity approach lighting system, separate circuiting of the centerline lights in the displaced area is not required since the high intensity approach lights will "wash out" the centerline lights.

b. Touchdown Zone Lighting. Touchdown zone lights consist of 2 rows of transverse light bars located symmetrically about the runway centerline as shown in Figure 2. Each light bar consists of 3 unidirectional lights facing the landing threshold. The rows of light bars extend to a distance of 3,000 feet (900 m), or one-half the runway length for runways less than 6,000 feet (1 800 m), from the threshold with the first light bars located 100 feet (30 m) from the threshold.

4. DESIGN.

a. Sequence of Installation. The installation of inrunway lights should be done, if possible, while the runway is under construction or when an overlay is made. This would allow for the installation of L-857 light base and transformer housings with a conduit system which is preferred. Even though lighting may not be programmed at the time of runway paving or overlay, installation of bases and a conduit system should be considered for future installation of inpavement lighting. Installation of the lighting system after paving is completed is very costly and requires a lengthy shutdown of the runway.

b. Lavout. Provide a design drawing showing the dimensional layout of the centerline and touchdown zone lighting systems prior to construction. Correlate this design with current airport drawings to utilize available ducts and utilities and to avoid conflict with existing or planned facilities.

c. Runway Centerline and Touchdown Zone.

(1) Light Fixtures and Wires. Design these systems for one of the conditions listed below:

'(a) In new rigid pavements and new flexible pavements, provide access to cables and transformers through the use of conduits and L-857 transformer bases. This type of installation will reduce downtime and repair costs when the underground circuits require maintenance. See Figures 3 and 6.

(b) In pavements being overlaid, a base and conduit system as shown in Figures 3 and 6 may be used. This provides the advantages listed in (a) above.

(c) In existing pavements, provide recesses or holes for the light-fixtures and shallow sawed wireways for electrical conductors. This method does not require the installation of bases and conduits. See Figure 7.

(2) **Electrical Power.** Design each system as a 20-ampere series circuit wing 8 constant current regulator. Except for special orders, regulators m supplied with primary input ratings of 2,400 volts. Provideeach light fixture with 8 20/6.6-ampere, 200-watt insulating transformer. To estimate the size (kilowatt capacity) of the constant current regulator, allow 250 watts for each 200-watt light fixture plus losses in the feed cable from theregulator to the light loop.

(3) **Electrical Control.** Make thecenterline lighting system's controls independent of the touchdown zone lighting system and thehigh intensity runway edge lights. Normal control circuit is 120 VAC. See special considerations next paragraph. Provide spare wires in the control cable for future use; 88 8 minimum, 20 percent is recommended.

d. **Special Considerations.**

(1) The load on the secondary of the 200-watt insulating transformer should not exceed the lamp load plus 0.40 ohm. it is not practical to stay within this limit, use 8 300-watt insulating transformer.

(2) Voltage drop between control tower and regulator must be considered. Control voltage at the regulator must be 100 volts (minimum). Ifthis voltage cannot be maintained, either an auxiliary low current AC relay must be installed at each regulator or 8 low voltage DC remotecontrol circuit must be employed. In some instances, it will be more economical, because of material costs, to install 8 low voltage DC control circuit even though the voltage drop is within acceptable limits with the standard 120 VAC system.

5. **EQUIPMENT AND MATERIAL.**

a. **Specifications and Standards.**

(1) Equipmentand material covered by specifications are referred toby advisory circular numbers.

(2) Distribution transformers, oil switches, cutouts, relays, terminal blocks, transfer relays, circuit breakers, and all other commercial items of electrical equipment not covered by Federal Aviation Administration specifications must conform to the applicable rulings and standards of theelectric81 industry.

b. Light Fixtures.

(1) Provide runway centerline light fixture8 that conform to AC 150/5345-37, L-850 Class A (Bidirectional).

(2) Provide touchdown zone light fixtures that conform to AC 150/5345-37, L-8S0 Class B (Unidirectional).

c. Insulating Transformers. Provide 200-watt insulating transformers (L-844) that conform to the requirements of AC 150/5345-33, and 300-watt insulating transformers that conform to MIL-T-27535. The transformers serve a8 a means of insulating the light unit from the high voltage of the series circuit. When a lamp filament opens, the continuity of the primary series circuit is maintained by the insulating transformer.

d. Light Base and Transformer Housings. Where required provide L-857 bare8 that conform to the requirement8 of AC 150/5345-42. The bases consist essentially of a cylindrical body with top flange and cable entrance hubs; an internal grounding lug may be specified by the user. The internal grounding lug is used where bases are interconnected with the duct and the ground wire is installed through the duct system. Certain application8 *may require* additional entrance hub8. Provide necessary cover8 a8 described in AC 150/5345-42.

e. Regulators. Rwide L-828 constant current regulator8 thatconform to the requirements of AC 150/5345-10. The regulator is designed for atep brightness control without interrupting load current. The assembly ha8 lightning arresters, open circuit and overcurrent protective devices, and *a* local control switch. All parts *are* suitably wired *at* the factory a8 a complete assembly. Series disconnects are required but are not furnished with the regulator; various rating8 are available.

f. Control Panel. System controls may ba installed in the existing control panel if space is available. Otherwise, provide an L-821 remote control panel that conforms to the requirements of AC 150/5345-3. The panel consists of a top panel plate and housing, toggle switches, terminal boards, and bright-88 controls, a8 required. The size of the panel and the number *of* components to be mounted on the panel must be specified for each installation. In areas where lightning is prevalent, lightning arrestors my be installed at the terminal point8 of this panel.

g. Auxiliary Relay Cabinet. L-841 auxiliary relay cabinet assemblies manufactured in accordancewith AC 150/5345-13 can be obtained for use in 40-volt DC control circuits. The assembly consists of an enclosure containing a DC power supply, control circuit protection,

and 20 pilot relays. In areas where lightning is prevalent, lightning arresters may be installed at the terminal points of this cabinet.

h. Cable. Cable for the series lighting circuit shall be single conductor (#6 or #8 AWG is usually sufficient), 5kv insulation, suitable for direct earth burial, Type B or C in accordance with Advisory Circular 150/5345-7. Control cable for 120 VAC control circuits shall conform to Advisory Circular 150/5345-7, Type A or C, 600-volt insulation. Number 12 AWG conductors are commonly used but the designer may choose other sizes to fit the med. Acceptable substitutes are cables conforming to Insulated Power Cable Engineers Association (IPCEA) Publication No. S-66-524 for the Type c cables and No. S-19-81 for the Type A and B cables. Cables for installation in sawed cuts In pavement, used for connecting lighting fixtures to the secondary of series lighting transformers, shall be #10 AWG, * stranded, type THWN. Cable for low voltage DC control circuits shall * conform to Rural Electrification Administration (REA) Bulletin 345-14, Specification PE-23, or REA Bulletin 345-67, Specification PE-39.

i. Connectors. Provide L-823 connectors to splice the L-824 primary cables. These connectors conform to the requirements of AC 150/5345-26. Use preinsulated crimp-type connectors suitable for * installation in wireways for splices from the #10 THWN wires to the * centerline and touchdown zone inset fixture leads.

j. Tape. Provldeplastlc and electrical insulating tapes of the types specified in AC150/5370-10, Item L-108.

k. Conduit and Duct. Provide conduits and ducts that conform to the requirements of AC 150/5370-10, Item L-110. Flexible conduit shall be 2-inch galvanized, liquid tight, with protective plastic covering.

1. Concrete. Provide concrete and reinforcing steel that conform to the applicable provisions of AC 150/5370-10, Item P-501.

m. Adhesives and Sealants. Select materials that conform to the requirements of AC 150/5370-10: Item P-605, Type III; P-606; or Specification FAA-E-2373. Other adhesives and sealers may be used if approved by the local Airports District Office of the Federal AviationAdministration.

(1) Wireways. Seal wireways (saw kerfs) with a liquid-type sealer. Use material described in Item P-606. Specification FAA-E-2373 material may also be used in flexible pavements. Select material that is compatible with the pavement. The pouring temperature of hot-poured materials shall not exceed 205° C.

(2) Inset Fixtures. Fixtures are held in place with Item P-606 material, liquid form and paste.

(3) Joints. Use joint sealing material conforming to Item P-605 across rigid pavement joints.

6. **INSTALLATION.**

a. General. This section recommends installation methods and techniques. Other methods and techniques, and variations of those outlined here, may be used provided they are approved by the appropriate FAA Airports District Office. Correct placement of the lights is of prime importance; to achieve this, careful attention to detail is required. The light beam must be aligned parallel to the centerline of the runway with a tolerance of ±1/2°. The lighting fixture must be level and the top of the fixture edge must be between +0 inch and -1/16 inch from the. pavement top; see Figure 2 for application of tolerance on crowned pavement sections. To achieve this result, the light base, whether in one piece or in sections, must be aligned and held in place with jigs until finally secured. This method of installation requires surveying that is precise. The installation must be made with utmost care to avoid remedial action which is very costly.

b. Transformer Base (L-857) and Conduit System.

(1) New Rigid Pavement. This system is preferred but requires careful attention to detail during installation. One of two conditions will be encountered during installation: the edge of existing pavement will be available as a reference for the new bases; or no existing edge is available and the bases must be set "in space." The availability .of an existing pavement edge simplifies the task of locating the light base. However, in both cases a jig or fixture is required to hold the base in position while the concrete anchor is placed. See Figures 4 and 5. Elevation of the base with respect to the runway surface and azimuth with respect to the centerline are two parameters that must be met. It is absolutely necessary that the elevation of the flange be at least three-quarters of an inch below the pavement finished surface. If less than three-quarters of an inch is left after paving, the lighting fixture will be unacceptably high. If more than three-quarters of an inch is left, adapter rings can be used to bring the lighting fixtures up to the correct elevation. Spacers and adapter rings are basically shims and can be used to bring the lighting fixture to the correct elevation. At each light location, make an excavation in the runway base which is large enough to accommodate the light base, the reinforcing steel cage, and concrete for the anchor. After the

excavation is completed, the light base and reinforcing steel cage are installed and held in place with the jig. See Figure 4. The jig will establish the elevation and azimuth of the base and maintain this position until the concrete and anchor are placed. A recommended practice is to connect each base to the conduit system with a length of liquid tight flexible conduit as in Figure 3. Flexible conduit will allow adjustments in light base alignment before the concrete anchor is placed. Care must be taken while placing the concrete anchor that neither the jig nor the light base alignment is disturbed. The jig must remain in place until the concrete has set. During paving operations the light base may be fitted with a steel cover plate (mud plate). See Figure 4. After the paving train has cleared the light base, remove excess concrete from the top of the base, and the edge of the opening around the base should be finished to a smooth radius. The surface of the pavement around the light base must be level with the surrounding pavement; dished and mound areas are not acceptable. After the pavement has hardened, check the elevation of the top flange in relation to the finished surface. It may be necessary to install a flange ring, or flange and spacer ring, to bring the light fixture to correct elevation. Next, install primary cable, transformers, and connectors. Connect lighting fixture to secondary cable. Install "O" ring gasket and torque holddown bolts to manufacturer's recommendations. If the paving technique utilizes more than one "pass" of the paving machine, the above procedure is altered as follows: a sectional light base is required; after the bottom sectioa has been installed as described above, the first pass is completed. The flange is then cleaned and the next section is installed with a sealant equal to RTV-118, as manufactured by General Electric Company, between flanges, and torqued in place. The paving proceeds, and the fixture is installed as above. Base and conduit systems are subject to water intrusion. A well-designed system will be equipped with drains at the low spots.

(2) New Flexible Pavement. A sectional base is required for flexible pavement. The bottom sectioa of the light base (including concrete anchor) and the conduit system are installed in the runway base as described in the preceding paragraph. It is then paved over. The light base, concrete anchor, and conduit backfill must not be higher than the base surface. After the paving is completed, a 2-inch hole is bored to accurately locate the center punch mark of the bottom section cover plate. This hole is used to measure the actual distance from the top of the pavement to the top of the cover plate. An extension threequarters of an inch less than the distance from the pave-at to the top of the mud plate should be obtained. Also, obtain a three-quarter-inch flange ring to allow for future adjustment of elevation. When

the extension is received, a hole one-half inch larger than the diameter of the light should be drilled and the extension, flange ring, and light fixture installed as described above. The space between the walls of the hole up to the top of the adapter ring should be filled with liquid P-606 sealant. See Figure 6.

(3) Flexible Overlay. The installation of a light base and conduit system in a pavement to be overlaid is similar to that of a new flexible pavement except the bottom section of the light base and the conduit are set in openings made in the existing pavement. The required concrete anchor and encasement of the conduit will be similar to that described in (2) New Flexible Pavement. The use of a short length of liquid tight flexible conduit is necessary to allow proper alignment. The remainder of the installation is as described in the preceding paragraph.

(4) Rigid Overlay. The installation of a lighting base and conduit system require8 a'comblnation of techniques outlined in preceding sections of (1) New Rigid Pavement, and (3) Flexible Overlay. The base and conduit are installed as in (3); concrete is placed as in (1).

c. Inset Installation.

(1) Rigid Pavements. Drill holes or recesses in the pavements to accommodate the light fixtures. Saw wireways to accommodate electrical circuits. See typical installation details in Figure8 7, 8, and 9.

(a) Pavement Drilling and Sawing. Provide approximately 1/4-inch clearance for sealer material between the bottom and side of the Ineet base receptacle and the recess. Provide extra depth where sawed wlreways cross pavement joints. See Figure. 7 for detail.

(b) Light Fixtures. Install centerline lights to follow the longitudinal pavement contour. Place touchdown zone lights level in a horizontal plane. Unless otherwise epeclfied, the tolerance for being level is ±1/2 °. See Figure 2.

1 Rlor to'placing the inset base receptacle in the drilled hole, clean all external surfaces to assure an adequate bond between fixture, sealer, and pavement. Sand blast if necessary. Avoid handling the fixtures by the leads.

2 Orientate the fixture and ● rrmge.the leedr'properly with respect to their splicing position in the wireway. Use temporary dams, if required, for blocking the wireway entrance into the drilled hole. The dams will retain the realer during the setting of the inset bare receptacle. The orientation tolerance for the bare is +1/2° from a line parallel with the rummy centerline: Rugged, well-designed jigs are required to • 88ura proper azimuth, ● levetioa, and level.

3 Cover the bottom of the inset base receptacle with a paste-type ● dhe8Fve material. , Place a sufficient quantity of paste in tha drilled hole. *Place* the bare in the drilled hole *to force* adhesive up the sides of the base at. least one-eighth inch. Care must be *taken* to work out entrapped air. Use a liquid sealer (paragraph 5m) to fill the space between the bare and sides of the hole. Liquid sealer should be ● pplied.only between the inset base receptacle and the sides of the hole, and should not be applied between the sides Of the hole and the top assembly.

(c) Wireways. Prior to the installation of the wires in the pavement, chamfer or round to 2-inch radius vertical edges of the wireways at intersections and corners. See Figure 10. Sandblast and clean wireways to insure proper bond between pavement material and the sealer. If wire-ways have been wet-sawed, flush there wireways with a high velocity stream of water immediately after sawing. Prior to installation *of* the sealer, the wireways must bedryandclean.

* (d) Wirer. Place the #10 THWN wires in the wireways from the transformers *near* the runway edge to the light fixture leads. Use an adequate number (3 feet maximum on centers) of wedges, clips, or similar device8 to hold the wires in place at least one-half of an inch below the payment surface. Wood wedge8 and plugs are not acceptable. Install the top of the wedge8 below the pavement surface. Splice the light fixture lead8 to the #10 THWN wirer. Use pre- * insulated connectors. Make the crimped splice with a tool that require6 a complete crimp before releasing. Stagger the location of the splices. Permit no splices in the single conductor wires except at each light. If the installation is made in stages, tape or real the ends of exposed wire8 to prevent *the* entrance of moisture. Seal the wires in the wireways with Item P-606 material. Apply in accordance with AC 150/5370-10 and the following steps:

1 Pour sealer in wireway until surface of wire is covered.

2 If recommended by the manufacturer, pour clean sand into the liquid sealer until a slight amount of sand shows on the surface. Use clean sand that can pass through a Number 40 sieve.

3 Fill the remainder of the wireway to pavement level with liquid sealer, but in no case above pavement level.

4 Sealer material extending above pavement surface must be removed.

(2) Flexible Pavement. Install light fixtures and wires in flexible pavements similar to the installation procedures in rigid pavements with the following precautions:

(a) Clean the holes and wireways immediately before installation so that the clean, dry aggregate of the pavement is exposed.

(b) Mix the P-606 sealant (for use on fixtures) so that it sets up within 15 minutes.

(c) Use sealant that conforms to P-606 or Specification FAA-E-2373 to seal wires in wireways.

(d) Junction boxes may be installed on runways, where overlays are anticipated. See Figure 10. When additional pavement is required, the inset light is removed and the base is fitted with a cover; paving is then applied over the light base and junction box. When the paving is completed, expose the junction box and light base by coring. Remove covers. Add extensions to the junction box and light base. Install cover on junction box extension, and install light on light base extension.

d. Vault.

(1) Install the airport vault and equipment in accordance with AC 150/5370-10, Item L-109.

(2) Exercise care while working in the vault to prevent drill deposits, iron filings, insulation stripping, or other foreign matter deposits from collecting on relays, switches, and other operating components. Collect and remove all residue as the installation progresses. Use covers or shields during installation and wiring to protect components from foreign matter.

e. Cable. Cable installation shall be in accordance with Item L-108, Advisory Circular 150/5370-10. In the event of a conflict between this paragraph and L-108, this paragraph shell govern. Provide sufficient slack to enable primary cable connections to be made above ground. There shall be no splices in the primary cable between light stations. Connections of cable to insulating transformer shall be made with L-823 cable connectors. Connectors on the primary side are taped; secondary connections are not. Use rubber tape, followed by plastic tape where connector and cable are joined. Use only plastic tape where the two connector halves meet. Tape cable ends if connections are not made immediately.

7. **INSPECTION AND TEST.**

8. **Base and Conduit Systems.** Inspection and testing of lighting systems during construction are important. Certain components may not be accessible for corrective action after the final installation.

(1) Inspect the installed light unit to determine if the equipment has been installed in accordance with the manufacturer's instructions and at the proper elevation.

(2) Check the alignment of all units to determine if all lighting fixtures have been installed in accordance with design and installation requirements.

(3) Check the fixtures and bases to determine if the securing hardware has been tightened in accordance with the manufacturer's instructions.

(4) Visually inspect the lighting fixture8 to determine if the lenses and channels in front of the lenses are clean.

(5) Tart vault equipment and primary circuit8 as specified in AC 150/5370-10, Item L-109 and L-108, respectively.

(6) Measure and record all operating voltage8 and currents, and insulation resistance.

b. Inset Lights. In addition to the above, perform the inspection and test for these lights concurrently with the installation because of subsequent -inaccessibility of some components. &fore filling wireways, identify and test the secondary series circuit for each subsector of runway for continuity and insulation resistance to ground. Check the insulation resistance with 8 500-volt (minimum) insulation resistance tester. An acceptable circuit ha8 a resistance of at least so megohms. After fixtures and wirer are installed, perform a visual inspection of the sealer in the wireways and around the fixture8 to determine if 811 voids are filled and that sealer is at the proper level with respect to the runway surface. After these

tests have been performed and the lighting circuits are completed, test the system by continuous operation for a period of not less than one-half hour prior to acceptance. The tests include the . operation of each control not less than 10 times.

a. **MAINTENANCE.**

a. General. Establish a maintenance program at airports where centerline and touchdown zone lights are installed to insure proper operation and dependable service from the equipment. The effectiveness of a system will soon depreciate unless it is properly maintained. Maintenance recommendations are contained in Advisory Circular 150/5340-22, Maintenance Guide for Determining Degradation and Cleaning of Centerline and Touchdown Zone Lights.

(1) Perform a daily operational check of all lighting fixtures. Energize the runway centerline and touchdown 'zone lights and visually inspect the light output. If any lamps are out or fixtures are obscured, record the location of the fixtures and replace the lamps or top fittings containing the optical lenses. Replace lamps when the circuit is deactivated.

(2) Clean the lighting fixtures regularly so that the system can meet performance requirements for low visibility conditions. Clean the lens and channel in front of the lens periodically in accordance with manufacturer's recommendations. The regularity and type of cleaning will be dictated by the weather conditions and the location of the fixtures.

(3) Snow should be removed from around the lights with a power broom if practical. If it becomes necessary for snowplows to cross lights, it is recommended that the blade be lifted. Only as a last resort should the blade be allowed to come in contact with the light. Rubber and plastic-edge snowplow blades are available that are especially suited for plowing wet or slushy snow. Recommended snow removal techniques are contained in AC 150/5380-2.

b. **Lamps.**

(1) Group Replacement. Group replacement may be beneficial and should be considered. It is recommended that lamps be replaced when the number of hours of operation on the top brightness step equals the lamps rated life.

(2) **Relamping.** Deenergite the circuit supplying the fixture containing the burned-out lamp. Remove the top assembly. A recommended practice is to replace the complete top assembly, and subsequently relamp it in a clean, indoor location. Replace the seals if they appear to be worn or damaged. Before the top assembly is replaced, clean and dry the unit. Properly

position and/or seat all gaskets. Tighten all screws, bolts, or other securing hardware in accordance with manufacturer's instructions. (If fixture8 are not properly secured, they might be damaged by normal aircraft operations.)

c. Removal of Water. The lighting fixtures are designed to exclude both ground and surface water from entering, However, water sometimes enters and becomes a serious problem, particularly where freezing temperatures are encountered. If the barer or receptacles fill with water, freezing may cause damage to the fixture by shearing the top assembly holddown hardware or rupturing the base or receptacle. To prevent this, establish a regular schedule for removing water especially during the fall and winter months. Establish a regular schedule for tightening cover holddown bolts. If any of the fixtures contain water, remove this water and clean and dry the receptacle, lamp, and electrical contacts. Properly position and/or seat all gaskets and tighten the hardware, securing the top assembly in accordance with the manufacturer's instructions.

d. Cable. Check home runs of cables with a 500-volt (minimum) insulation resistance tester before the installation has been accepted. Make records of the resistance values obtained. In order to check the condition of the system, compare periodic reading6 with the initial values. In an acceptable system, the initial insulation resistance value is not less than 50 megohms and usually is much higher (in the order of hundreds of megohms). If the periodic checks reveal progressive deterioration or faults, take corrective steps promptly.

(1) Make periodic insulation checks by first deenergizing the regulator. Monthly checks are recommended. Open the series disconnects. Connect one lead of the insulation resistance tester to the load side of one disconnect; connect the other lead to a proven ground. Operate the test equipment in accordance with instrument instructions.

(2) Maintenance personnel must be cautioned that high open-circuit voltage is present when the secondary of an energized constant current regulator is opened. Troublerhooting is complicated by the fact that in some instances the interconnecting wires are sealed in the runway pavement8 and the fixtures are located in an active part of the runway. For this reason, it is important to check the system during the installation and to establish an effective preventive maintenance program.

e. Spare Parts. The importance of stocking spare parts cannot be overemphasized. Spare lamps, for example, should be procured when the lighting system is put into Operation, and not when the lights begin to go out. Experience indicates that frantic requests for immediate delivery of replacement lamps often cannot be met by the supplier. Replaceable parts of fixtures and replaceable components of regulators should also be stocked for maintenance purposes.

f. Vault. Keep the vault (AC 150/5370-10, Item L-109) uncluttered to prevent dirt from accumulating in control compartmenta and to allow equipment to be accessible at all times. Mount legible warning signs in conapicious places. Make periodic checks of supply voltage and output current.

g. Test Equipment. To measure the light output Of inpavement lighting, obtain the equipment described in AC 150/5340-22, Maintenance Guide for Determining Degradation and Cleaning of Centerline and Touchdown Zone Lights. In addition, the following equipment is recommended:

500-volt (minimum) insulation resistance tester.
Volt-ohm meter and clamp-on ammeter
Rubber safety gloves.
Hot stick.

Other test equipment as required by a particular site.

APPENDIX 1. BIBLIOGRAPHY

* 1. Advisory Circular (AC) 00-2, Federal Register, Advisory Circular Checklist and Status of Federal Aviation Regulations (FAR), updated triannually, contains the listing of all current issuances of advisory circulars and changes thereto. It explains the circular numbering system and gives instructions for ordering advisory circulars that are for sale as well as those distributed free of charge. AC 00-2 also gives instructions for ordering the Federal Aviation Regulations.

a. The following free advisory circulars may be obtained from the Department of Transportation, Publications Section, TAD-443.1, Washington, D.C. 20590:

(1) AC 00-2, Federal Register, Advisory Circular Checklist and Status of Regulations.

(2) AC 150/5000-3, Address List for Regional Airports Divisions and Airports District Offices.

(3) AC 150/5340-19, Taxiway Centerline Lighting System.

(4) AC 150/5340-22, Maintenance Guide for Determining Degradation and Cleaning of Centerline and Touchdown Zone Lights.

(5) AC 150/5345-3, Specification for L-821 Airport Lighting Panel for Remote Control of Airport Lighting.

(6) AC 150/5345-7, Specification for L-824 Underground Electrical Cables for Airport Lighting Circuits.

(7) AC 150/5345-10, Specification for L-828 Constant Current Regulators..

(8) AC 150/5345-13, Specification for L-841 Auxiliary Relay Cabinet Assembly for Pilot Control of Airport Lighting Circuits.

(9) AC 150/5345-26, Specification for L-823 Plug and Receptacle, Cable Connectors.

(10) AC 150/5345-42, FM Specification L-857, Airport Light Bases, Transformer Housing, and Junction Boxes.

(11) AC 150/5345-46, Specification for Semiflush Airport Lights.

(12) AC 150/5345-47, Isolation Transformers for Airport Lighting Systems.

(13) AC 150/5380-2, Snow Removal Techniques Where In-Pavement Lighting Systems are Installed *

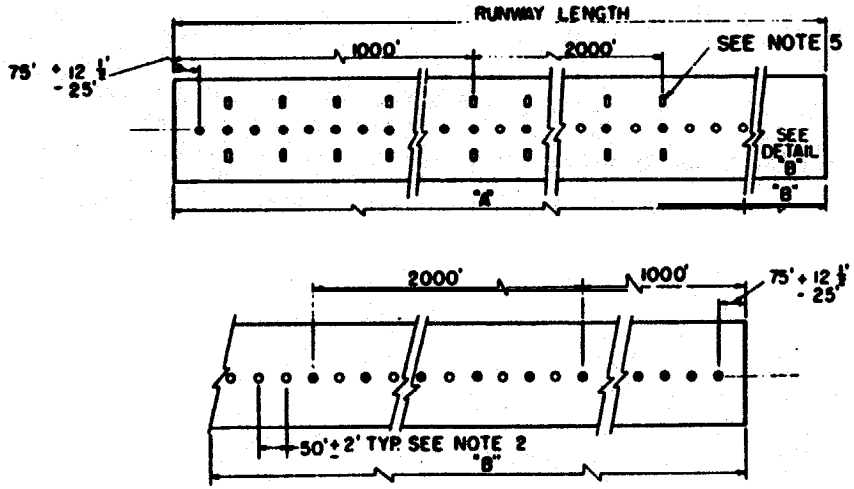
* b. The latest Issuance of AC 150/5370-10, Standards for Specifying Construction of Airports, which can be found In AC 00-2, may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

2. Obtain copies of Rural Electrification Administration (REA) Bulletin 345-14, Specification PE-23 for Telephmo Cables for Direct Burial, and REA Bulletin 345-67, Specification PE-39 for Filled Telephone Cables, from U.S. Department of Agriculture, Rural Electrification Administration, Information Services Division, Washington, D.C. 20250.

3. Obtain copies of Military Specification MIL-T-27535 (ASG), Transformer Power, Isolation: Series Circuit, Airport Lighting General Specification for, from Commanding Officer, Naval Supply Depot, 5901 Tabor Avenue, Philadelphia, Pennsylvania 19120, Attention: Code CDS.

4. Obtain copies of Specification FAA-E-2373, Adhesive Compound, Two-Component for Sealing Wire in Flexible Pavements, from Federal Aviation Administration, Configuration Control Branch, AAF-110, 800 Independence Avenue, S.W., Washington, D.C. 20591.

5. IPCEA Publications S-66-524, Cross-linked-thermosetting-polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy, and S-19-81, Ribber-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy, may be obtained from the National Electrical Manufacturers Association, 155 East 44th Street, New York, New York 10017. *



DETAIL "B"

SYMBOLS

() – Unidirectional touchdown zone light bar, 3 lights per bar

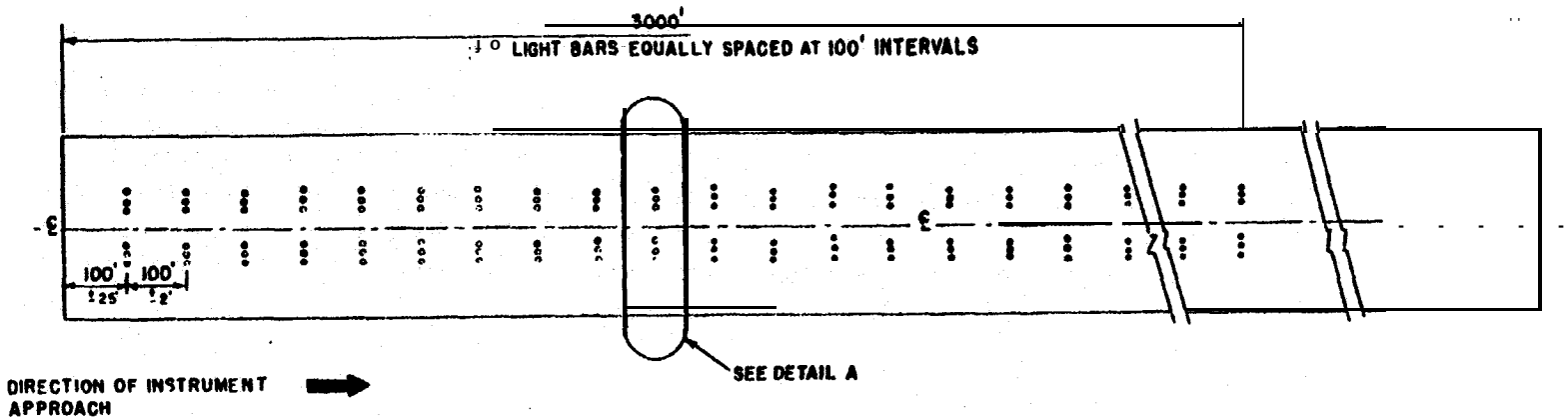
o – Bidirectional runway centerline light white both directions

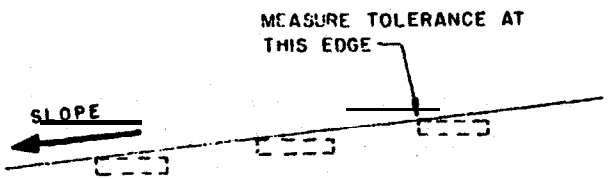
row – Centerline lights white (w) one direction and red (r) opposite direction

NOTES

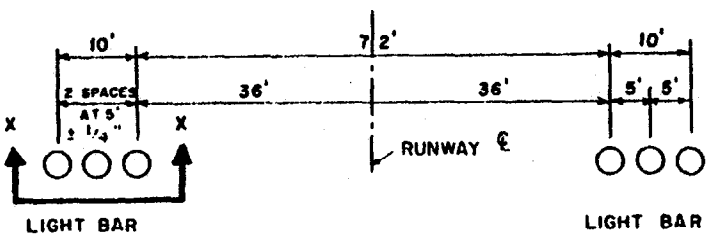
1. Centerline lights may be offset 2' to the right or left of the runwoy centerline lo avoid the centerline paint markings.
2. The centerline lights may have 0 longitudinal tolerance of ± 2', o lateral tolerance of ± ¼".
3. The last 3000 ± foot to 1000 ± foot section of the runwoy centerline displays on alternate red and white light rignol.
4. The last 1000 - foot section of the runwoy centerline displays on all rod signal.
5. The touchdown zone light bon are not required to be locotrd at the same stations as the centerline lights. See figure 2 for configuration.

FIGURE 1. RUNWAY CENTERLINE LIGHTING LAYOUT





SECTION X- X



DETAIL A

NOTES

1. THE LONGITUDINAL INSTALLATION TOLERANCE IN LOCATING THE PAIRS OF TRANSVERSE LIGHT BARS SHOULD NOT EXCEED 2 FEET LATERAL TOLERANCE OF LIGHTS IN A BAR IS ± 1/4".

2 THE SPACING BETWEEN THE INNERMOST TOUCHDOWN ZONE LIGHT FIXTURES SHOULD BE UNIFORM THROUGHOUT THE LENGTH OF THE SYSTEM. THIS SPACING IS 72 FEET EXCEPT WHERE CONSTRUCTION PROBLEMS PREVENT THIS SEPARATION. IN THIS CASE, THE UNIFORM SPACING IS REDUCED TO NO LESS THAN 65 FEET.

FIGURE 2. TOUCHDOWN ZONE LIGHTING LAYOUT

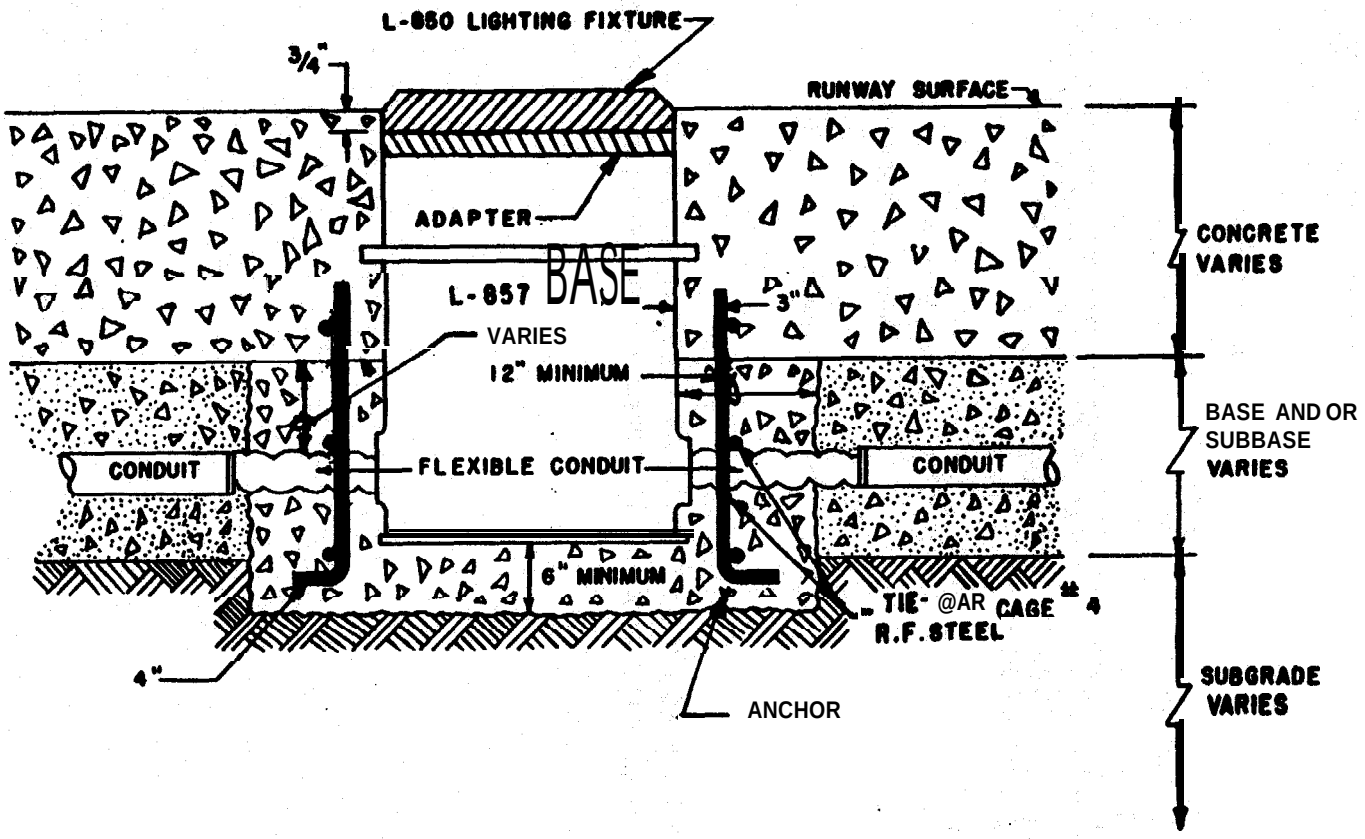


FIGURE 3. SECTION THROUGH BASE AND ANCHOR. BASE AND CONDUIT SYSTEM, RIGID PAVEMENT

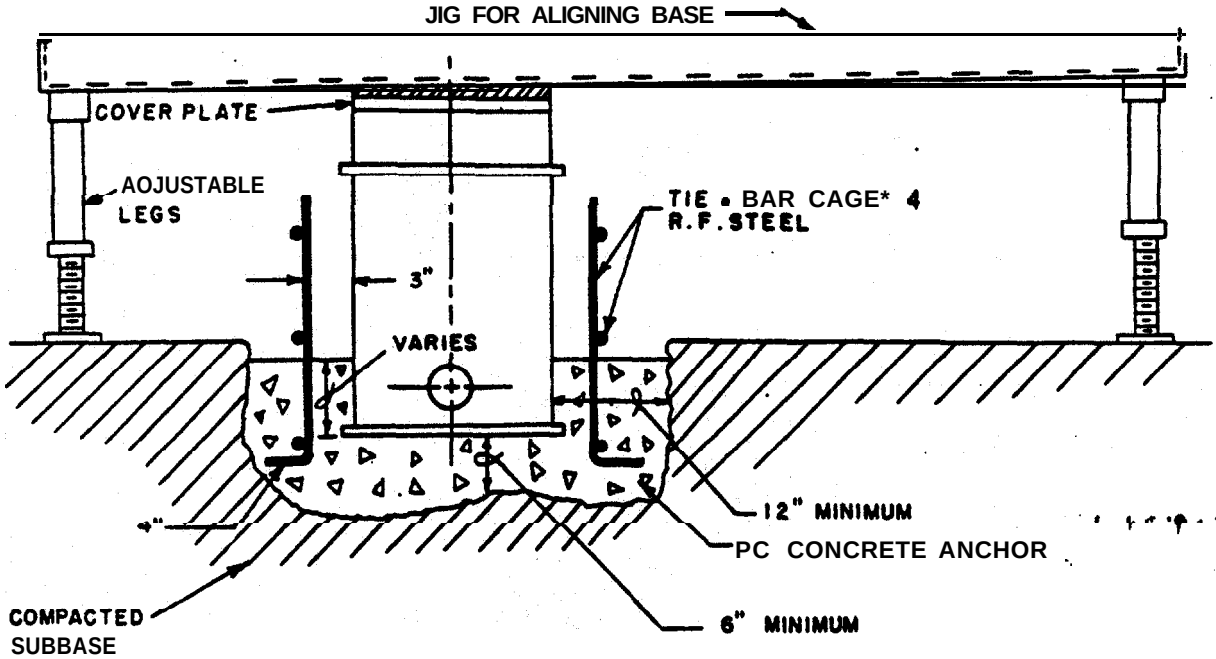


FIGURE 4. USE OF ALIGNMENT JIG, NO REFERENCE EDGE AVAILABLE, BASE AND CONDUIT SYSTEM

NOTE:

1. COVER PLATE SHOWN FOR ILLUSTRATION ONLY. USE OF MUD PLATES, CONSTRUCTION RINGS EXTENSIONS, ETC, DEPENDENT ON PAVING TECHNIQUES.

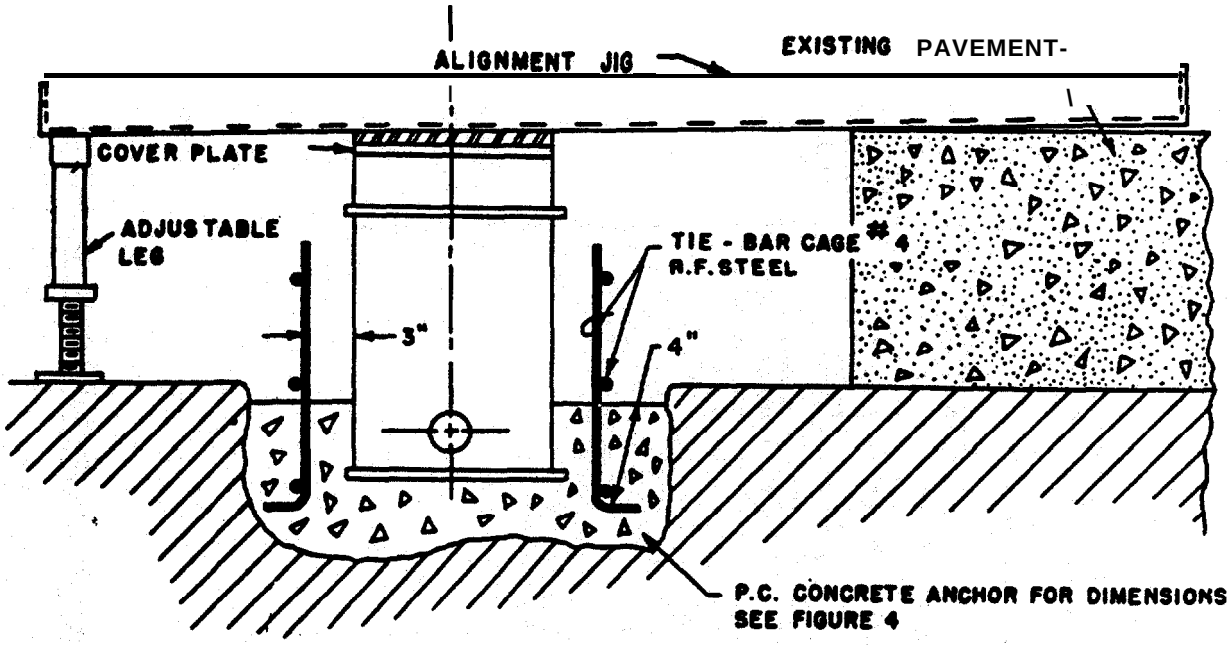


FIGURE 5. USE OF ALIGNMENT JIG, REFERENCE EDGE AVAILABLE

NOTE:

1. COVER PLATE SHOWN FOR ILLUSTRATION ONLY. USE OF MUD PLATES, CONSTRUCTION RINGS, EXTENSIONS, ETC., DEPENDENT ON PAVING TECHNIQUES

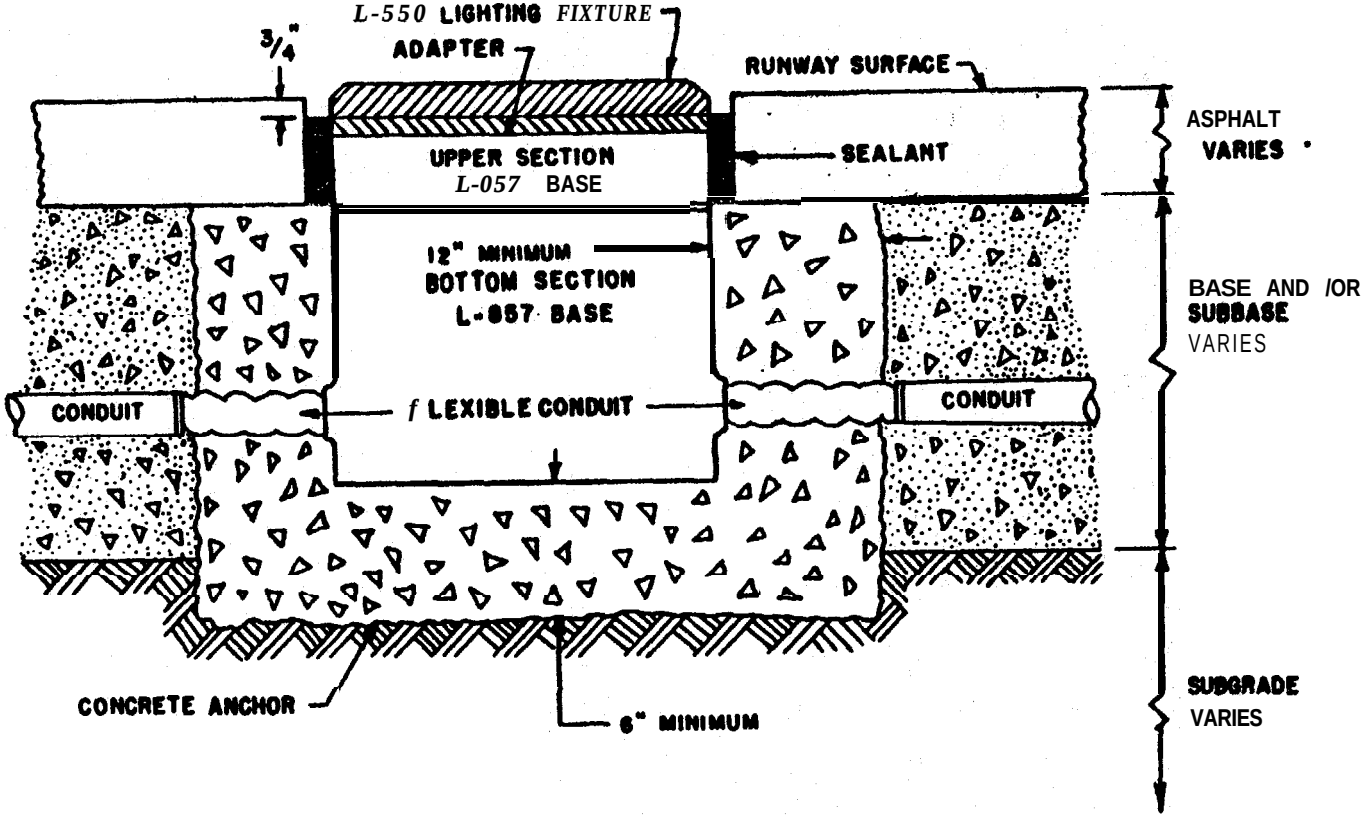


FIGURE 6. SECTION THROUGH BASE AND ANCHOR, BASE AND CONDUIT SYSTEM, FLEXIBLE PAVEMENT

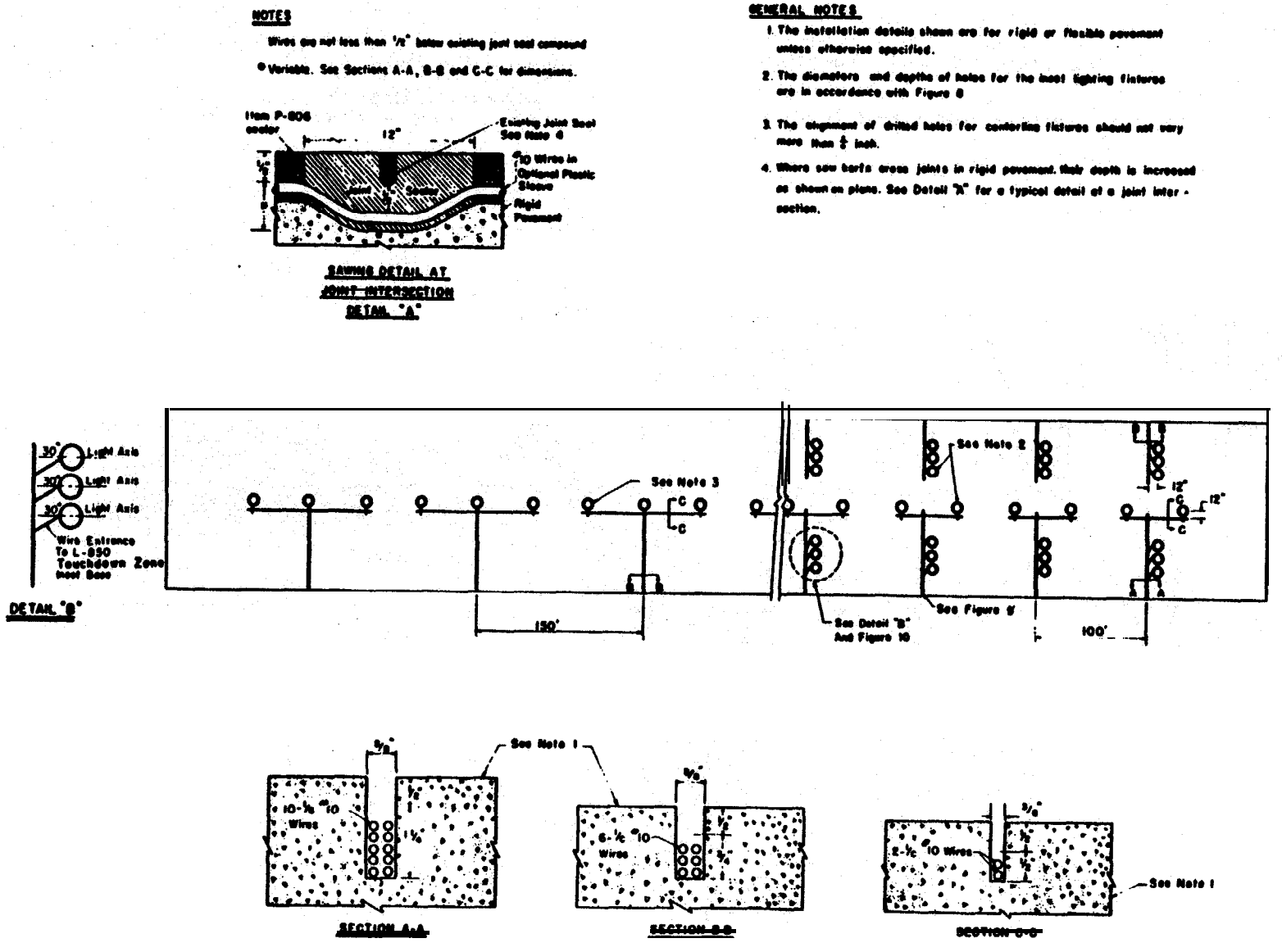
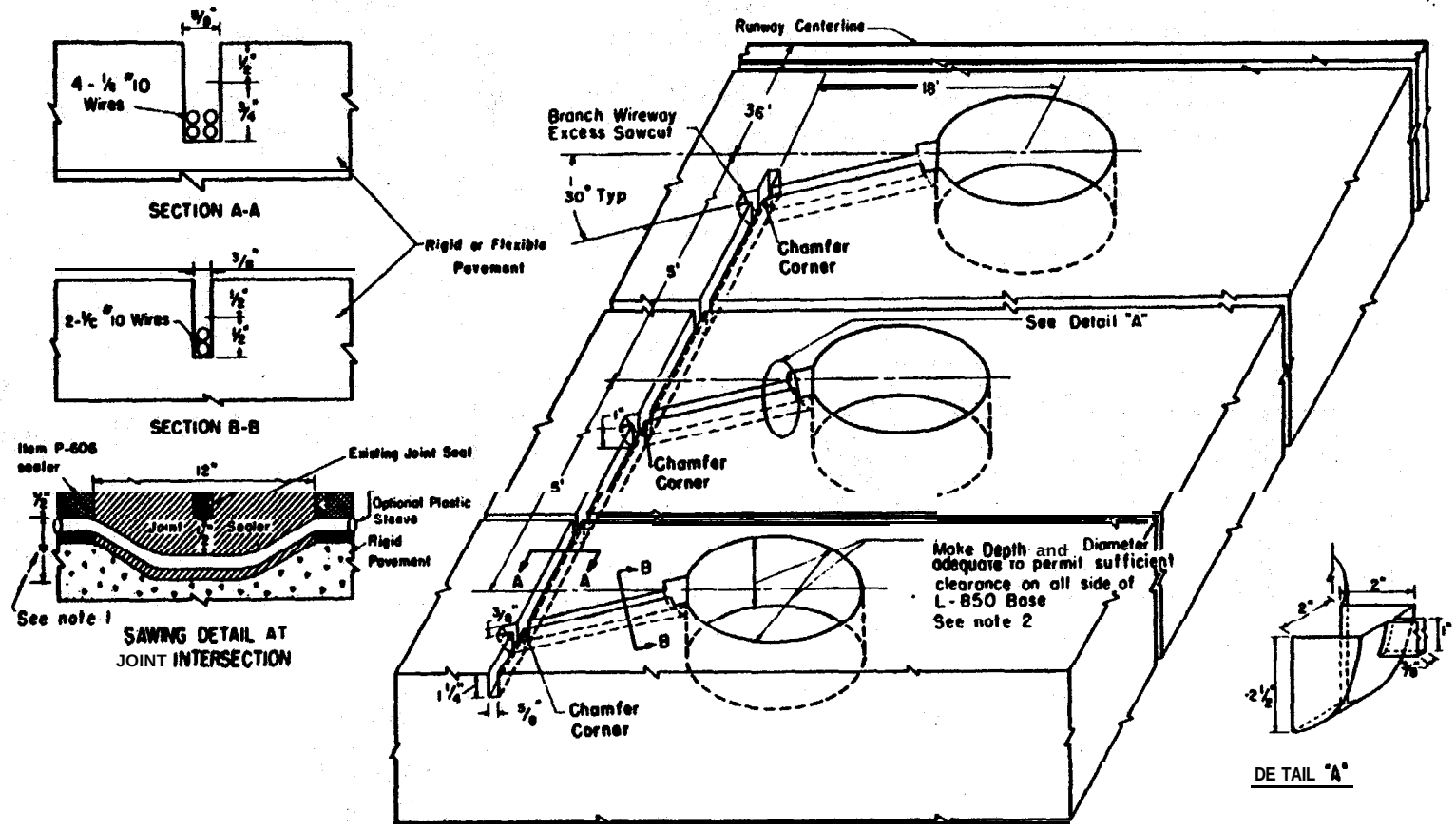


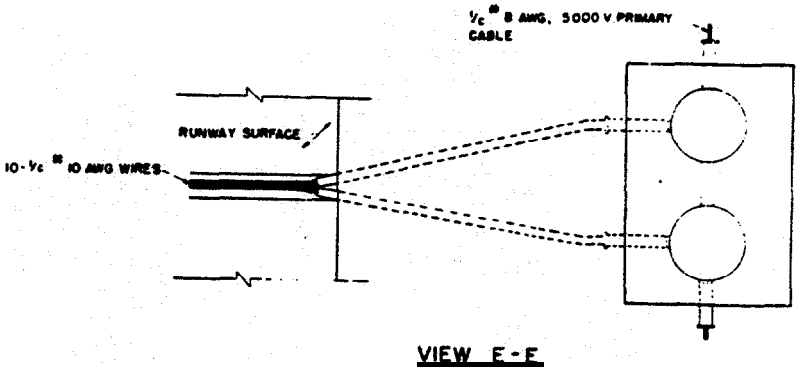
FIGURE 7. TYPICALWIREWAY INSTALLATION DETAILS FOR TOUCHDOWN ZONE AND CENTERLINE LIGHTS



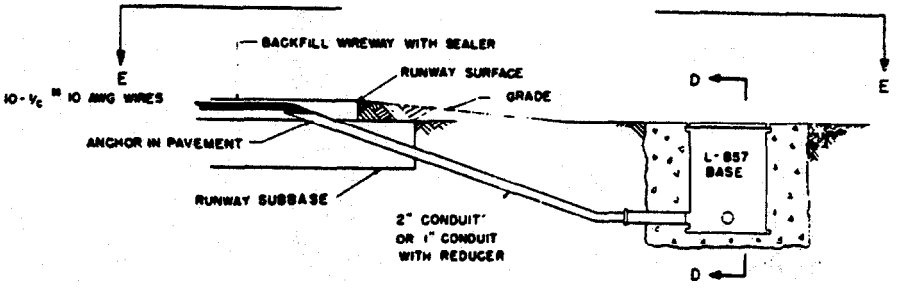
NOTES

1. * Place wires not less than 1/2" below existing joint seat compound, variable, see Sections A . A and B-B for dimensions.
2. The dimensions of cored hole for the L-850 BS fixture are: . Depth 4" . Diameter . 12 1/2".

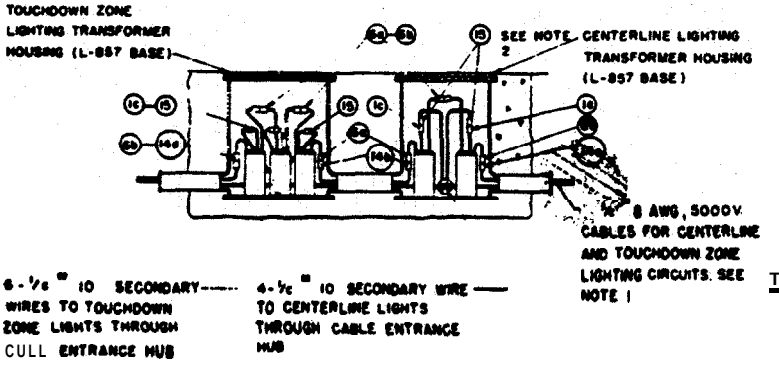
FIGURE 8. TYPICAL INSTALLATION DETAILS, INSET TYPE LIGHTING FIXTURES

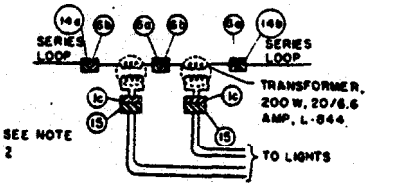


VIEW E-E



TYPICAL TRANSFORMER HOUSING INSTALLATION DETAILS





TRANSFORMER CONNECTIONS - TYPICAL

SECTION D - D

NOTES:

1. THE PRIMARY CABLES ARE INSTALLED IN ACCORDANCE WITH ITEM L-106 OF STANDARDS FOR SPECIFYING CONSTRUCTION OF AIRPORTS.
2. CABLE CONNECTORS-NUMBERS REFER TO SPECIFICATION L-823 FIGURE NUMBERS.

FIGURE 9. TYPICAL HOUSING INSTALLATION DETAILS INSET TYPE LIGHTING FIXTURES

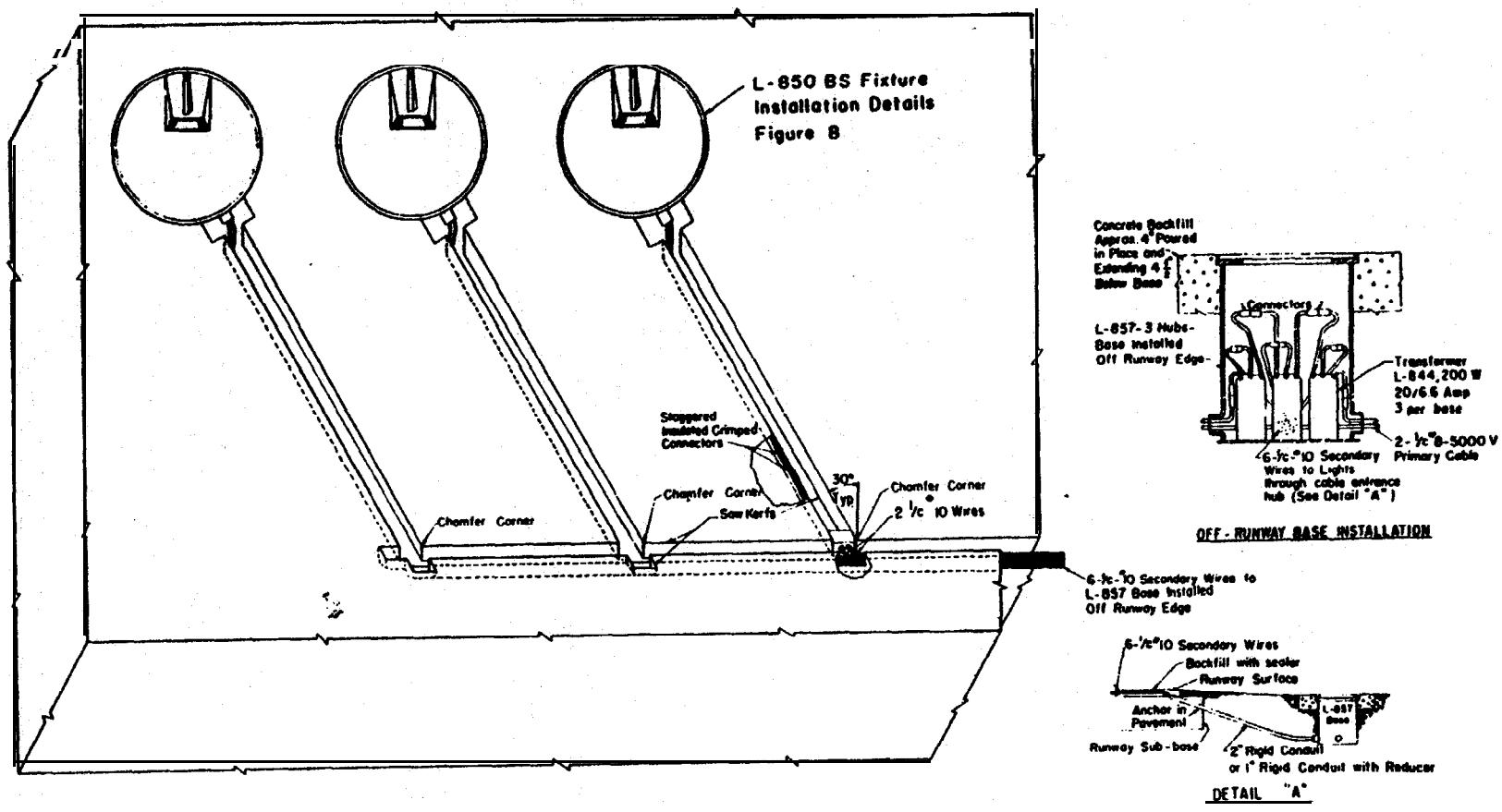
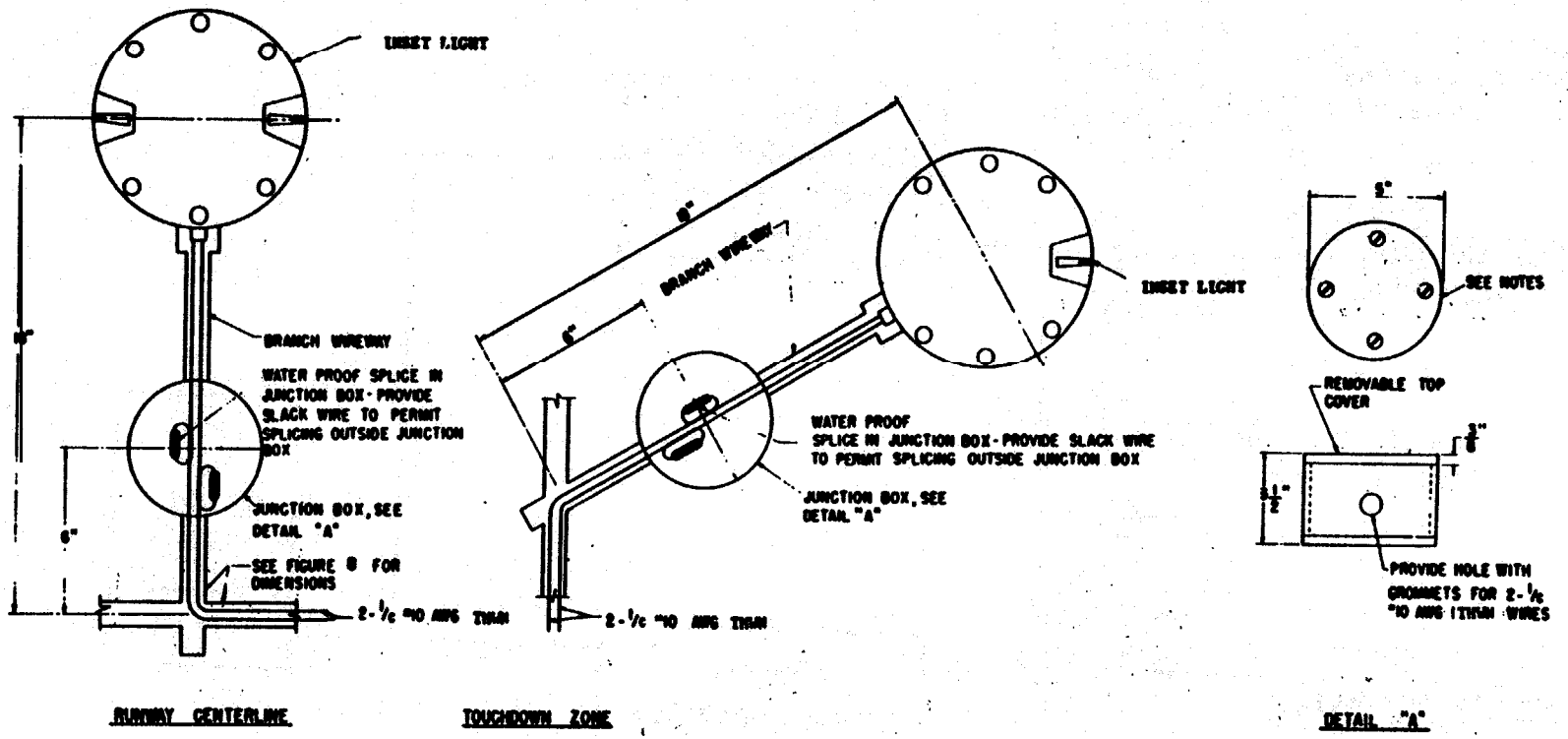


FIGURE 10. TYPICAL EQUIPMENT LAYOUT, INSET TYPE LIGHTING FIXTURES



NOTES

1. Provide metal to metal contact between the top cover and the base of the junction box.
2. Fill junction bon with o commercial non-setting material. This material is used to prevent water from collecting in the junction bor
3. Provide o suitable gasket ond grommets lo contain non-setting material in junction boa.
4. Design and fabricate the junction box lo meet the food requirements in specification L-850.
5. Install the junction box level with the surrounding pavements.
6. Zinc plate the box and cover to permit installation and &vice in pavements.

FIGURE 11. JUNCTION BOX FOR INSET FIXTURE INSTALLATIONS

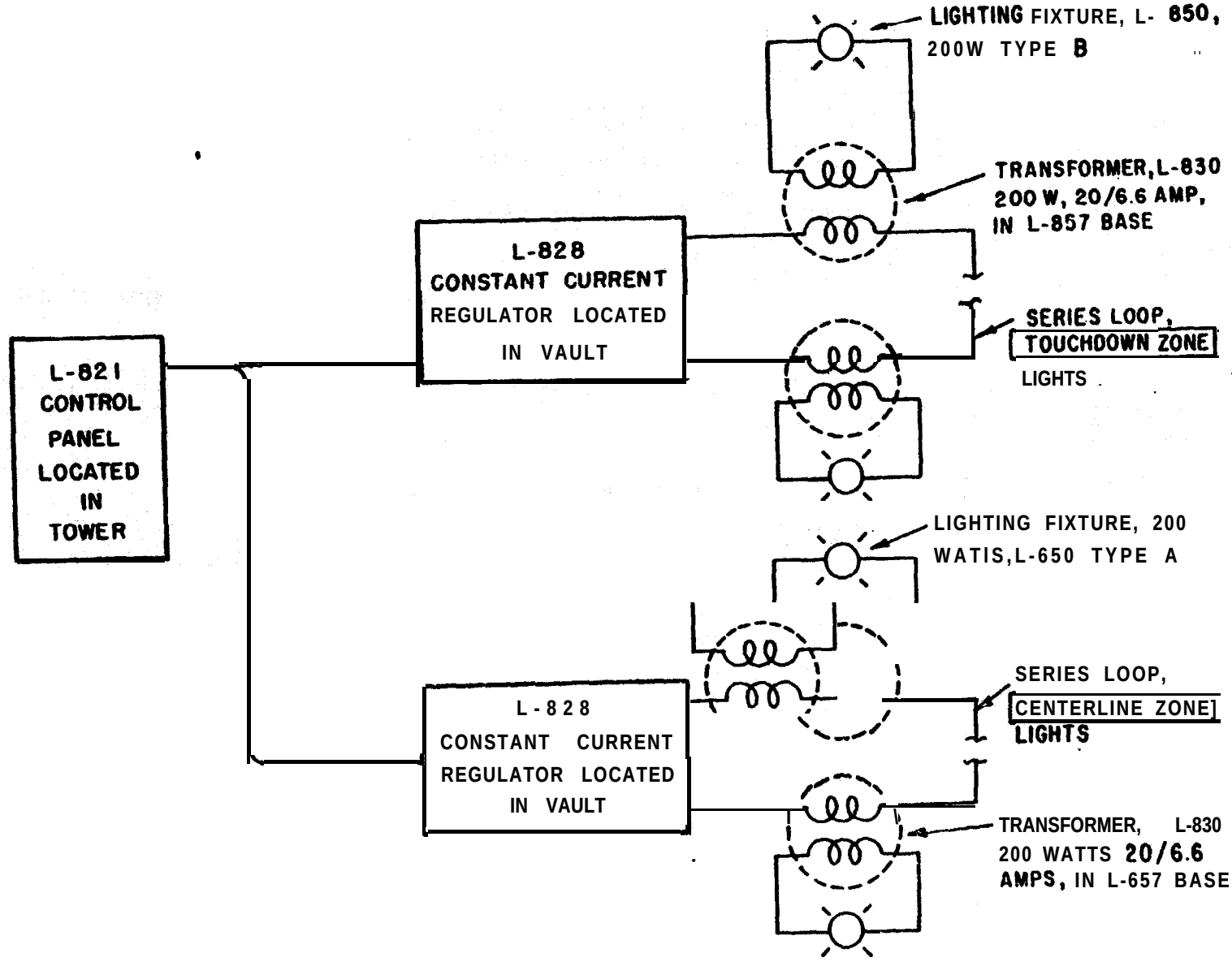
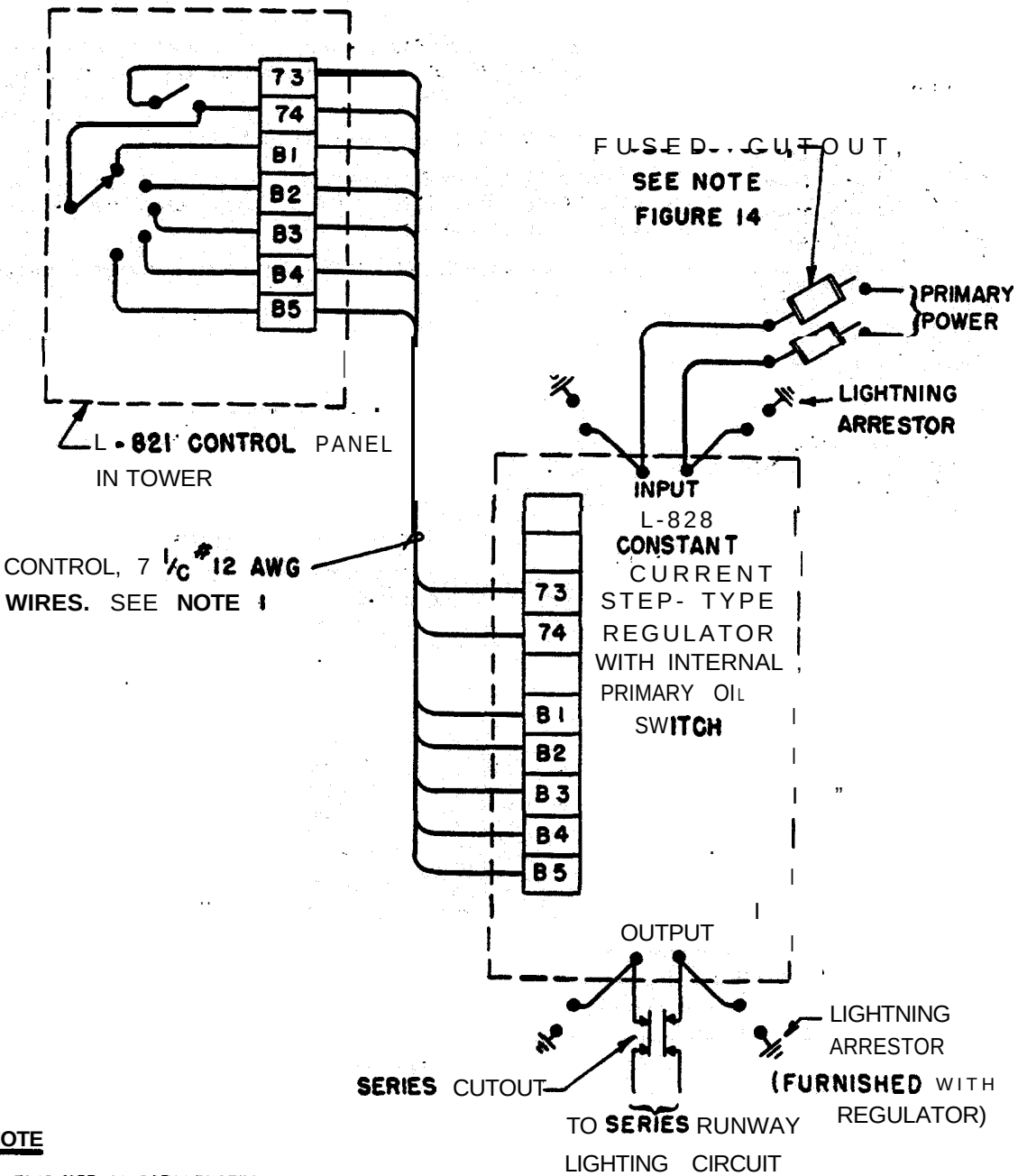


FIGURE 12. ONE LINE DIAGRAM, **TYPICAL** SERIES LIGHTING **CIRCUIT**



NOTE

1. THIS METHOD SATISFACTORY FOR ONE WAY CONTROL CIRCUIT LENGTHS UP TO APPROX. 3000 FT. OR WHERE VOLTAGE DROP IS NOT EXCESSIVE. WHERE VOLTAGE DROP IS EXCESSIVE, RESULTING IN 100 VOLTS OR LESS AT REGULATOR CONTROL TERMINAL, LOW VOLTAGE DC CONTROL MUST SE USED.

FIGURE 13. TYPICAL WI&G DIAGRAM, L-828 REGULATOR WITH INTERNAL CONTROL POWER AND PRIMARY OIL SWITCH

NOTES

1. AS A MINIMUM THE ELECTRICAL INSTALLATION SHALL CONFORM TO APPLICABLE SECTIONS OF THE NATIONAL ELECTRICAL CODE AND LOCAL CODES
2. 48 V DC MAY SE USED, SEE NOTE I FIGURE 13.
3. WHEN COUNTERPOISE WIRE IS REQUIRED IT SHALL BE INSTALLED IN ACCORDANCE WITH ITEM L-108 OF STANDARDS FOR SPECIFYING CONSTRUCTION OF AIRPORTS.
4. LIGHTNING ARRESTORS ARE FURNISHED WITH L-828 REGULATOR.

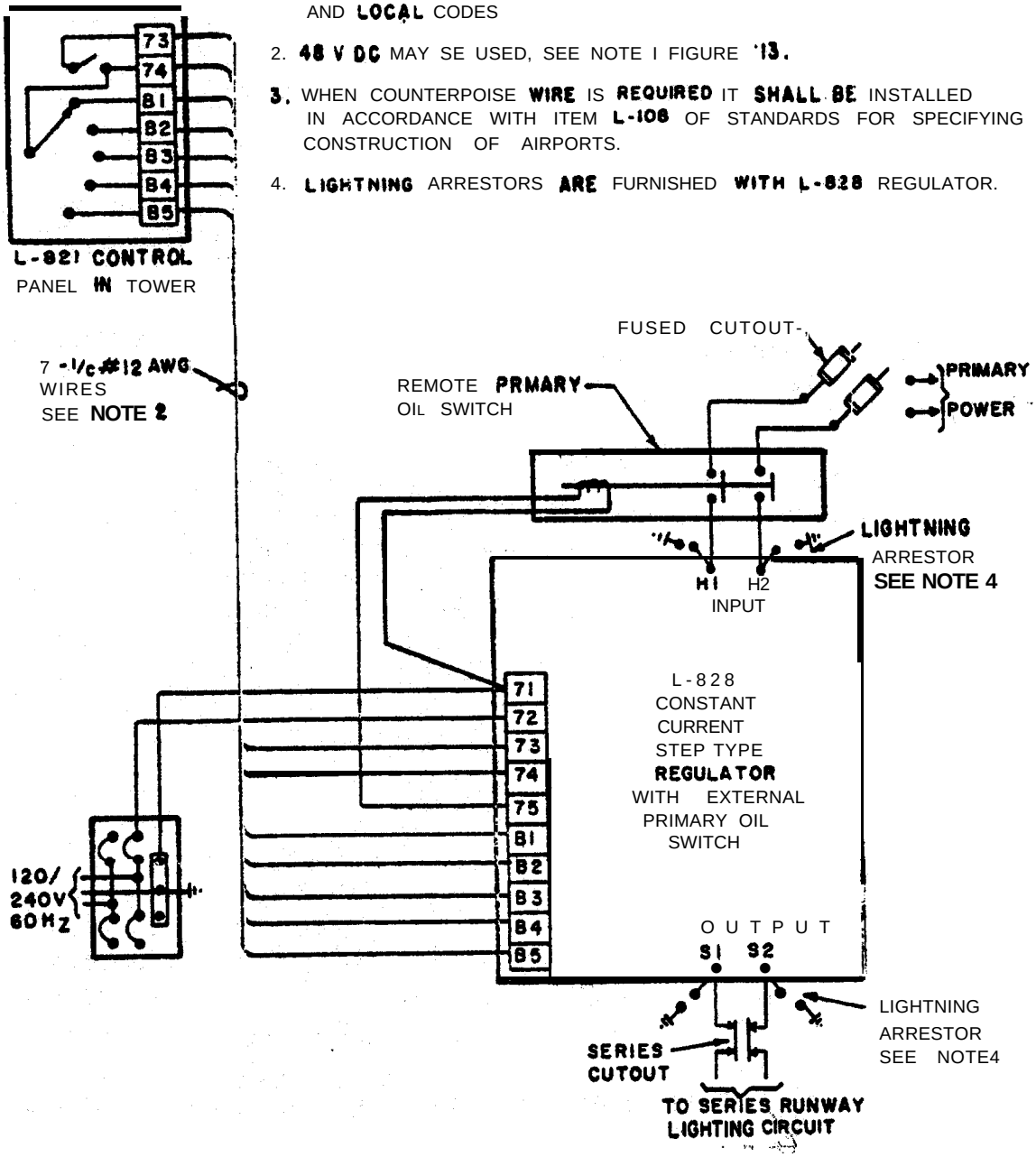


FIGURE 14. TYPICAL WIRING DIAGRAM, L-828 REGULATOR WITH EXTERNAL CONTROL POWER MD PRIMARY OIL SWITCH